Space Shuttle Engine Technology Research Benefits American Jet Engine Manufacturer

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NASA Space Shuttle technology is paying big dividends for one of the nation's largest manufacturers of jet engines for aircraft, Pratt & Whitney (P&W) of East Hartford, CT.

As a spinoff of an experimental investigation conducted at MSFC, significant improvements have been incorporated into the design of a P&W jet engine. The technological enhancements are applicable to other turbine designs, as well.

In 1992, a series of tests were conducted to experimentally investigate the settings of the blades and vanes of the turbine components on Pratt's high-pressure fuel turbopump for the Space Shuttle Main Engine. These tests were part of a cooperative program between NASA and P&W, one of America's premiere jet engine/rocket engine manufacturers, to experimentally study performance improvements possible by repositioning turbine blades relative to one another.

In the test rigs there were two sets of rotating turbine blades, called rotors, and two sets of stationary vanes, called stators, which direct the flow of hot combustion gases. The 50 airfoil-shaped blades on each of the 2 rotors and 54 vanes on the 2 stators are aligned consecutively, one after the other.

The Marshall and P&W engineers studied the effects of slightly rotating the vanes on stator two relative to their upstream counterpart. The vanes were thus slightly out of direct alignment. Tests also studied similar rotational adjustments on the blades of rotor two relative to those on rotor one. P&W engineers were later able to apply the experimental test data obtained in the Marshall Center tests to modify turbine rotor designs in the PW–4084 engine for the Boeing 777.

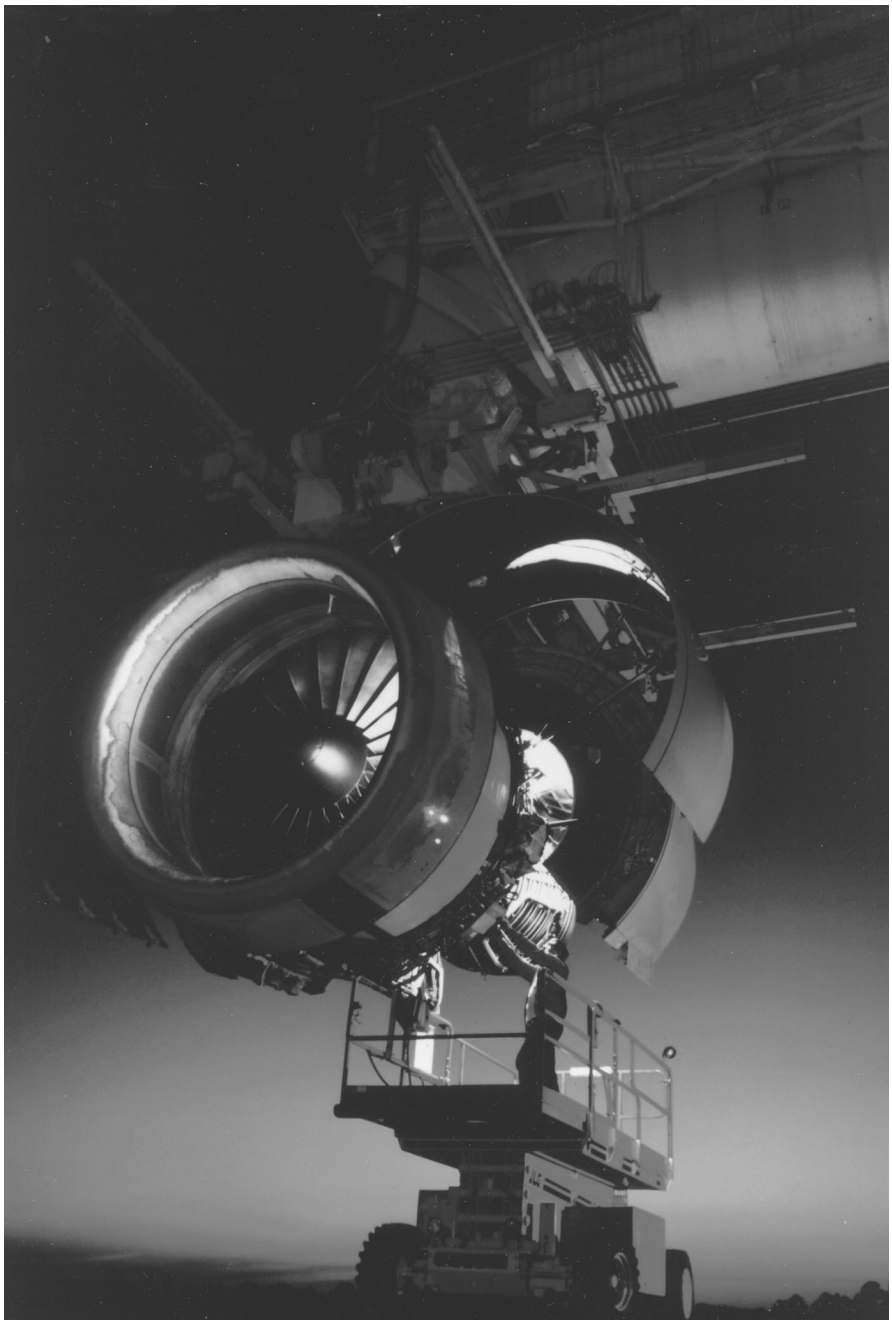

FIGURE 208.— A spinoff of an experimental investigation produced significant improvements to the design of a Pratt & Whitney jet engine.

Researchers at Marshall included: Stephen Gaddis and Lisa Griffin of the Structures and Dynamics Laboratory. Supporting them were John Heaman, William Neighbors, and William Kauffman of the Structures and Dynamics Lab and Richard Branick of Dynamic Engineering Inc., of Laceys

Spring, AL, the support contractor for the lab. They worked with F.W. Huber, P.D. Johnson and A.K. Finke of P&W's West Palm Beach, FL, facility, and O.P. Sharma from P&W's jet engine facility in East Hartford, CT.

The research team learned that a significant improvement in engine efficiency could be attained through the application of this innovative alignment of turbine rotor and stator blades. By applying this concept to the new P&W engine's rotors, they were able to improve its efficiency by a full half-percent. This is a significant improvement.

A twin-engined Boeing 777 aircraft using improved P&W–4084 engines flying a round-trip between Los Angeles and Hong Kong—a total distance of about 12,500 miles—would save about 400 gal of fuel. For shorter, transatlantic flights of about 6,000 miles round-trip, the savings would be about half that for Pacific operations. On an average, transoceanic airliners fly their routes three times a week. Extrapolating the fuel savings for the entire projected airline industry fleet of 92 Boeing 777 jets equipped with improved P&W–4084 engines over the course of a year of operations, shows an anticipated savings of more than 4 million gal of fuel—the equivalent of more than 650,000 barrels of oil.

The Pratt & Whitney engine is one of three being offered by Boeing for customers of the 777. The new Pratt & Whitney engines are projected to be installed on 40 percent of all Boeing 777's manufactured.

Some other benefits will accrue to the U.S. economy from these new engines besides greatly improved airline efficiency. U.S. airplanes and the new fuel-efficient engines will gain an important competitive edge in the international aircraft marketplace.

As a result of the tests conducted at MSFC, the fine tuning of the airfoil blade settings also may find an application in the large electricity-generating turbines used by America's utilities. By increasing generator turbine efficiency, electric utilities could achieve significant operational cost savings. In the case of electric turbines run by fossil fuels, greater efficiency of operation means lower fuel costs and the possibility of reduced pollution.

With America's electric utilities moving rapidly toward deregulation and increased competition, this means there will be great pressure to pass the savings on in the form of lower electric rates to the consumer.

"NASA efforts working with U.S. firms in transferring technologies from the Nation's space program to the public sector are proving to be very effective," said Harry Craft, manager of the Marshall Center Technology Transfer Office. "NASA is actively returning to U.S. industry the technologies for which the American taxpayer has paid and rightly expects to receive from this Nation's space program."

NASA will provide up to 40 hours of free technical assistance to U.S. businesses and industries. For further information on NASA Technology Transfer activities, call 1–800–USA–NASA.

Sponsor: Office of Commercial Development and Technology Transfer

Biographical Sketch: Bob Lessels is the technical writer/editor (physical sciences) for the Technology Transfer Office at the Marshall Center. A graduate of the University of Nebraska, he has been a professional journalist for the past 30 years. He joined NASA in 1986.